1985 AIR QUALITY DATA SUMMARY

REGIONAL MUNICIPALITY OF WATERLOO AND THE COUNTY OF WELLINGTON

September, 1986

Ministry of the Environment
Ontario

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West Central Region

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Air Quality Assessment
Technical Support Section
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INTRODUCTION

This report summarizes the 1985 results of air monitoring in the Regional Municipality of Waterloo and the County of Wellington in 1985.

The Ministry of the Environment's West Central Region has conducted routine monitoring in the area since the early 1970's. The Air Management Program in Ontario is based on controlling man-made emissions to meet ambient air quality objectives. These in turn are based on known effects on health, quality of life or sensitive vegetation, whichever is most stringent. To achieve these objectives, sources of pollution are identified, their emissions evaluated and appropriate control measures are instituted. Ambient air monitoring is used to identify pollution sources, evaluate the need for controls and then determine whether controls have been successful.

In addition to monitoring specific industrial sources, monitoring of a more general nature is also carried out in various localities to ensure that air quality objectives are being met and to observe trends in air pollution.

MONITORING NETWORK

The Ministry of the Environment's West Central Region operates a network of monitors in the area in Ayr, Breslau, Guelph and Kitchener. Much of the monitoring is performed near industrial sources, in many cases, as a response to local complaints. Monitoring of a more general nature is also carried out at single stations in Guelph and Kitchener to characterize air quality in larger population centres.

Meteorological data (wind speed and direction) are not measured by the Ministry in the area. However, data measured by the University of Guelph at their Elora research station is provided to the Ministry for data analysis. Figure 1 illustrates the wind frequency distribution for the area and shows that winds from the southwest, west and northwest quadrants predominate almost 50% of the time. Consequently, wherever possible, stations are located "downwind" of suspected pollution sources with respect to these winds.

Wind data were utilized in a computer program known as a "pollution rose" - essentially a cross-tabulation of average hourly pollutant concentrations with wind direction. The data from this program are illustrated on various maps in this report and are a useful tool in determining the impact on any given source on a monitoring station. The length of each line of the "rose" is proportional to the average concentration when the wind was blowing from that direction.

POLLUTANTS MONITORED

Two basic types of air pollutants are measured-gases and particulates (dust).

a) Gases measured with continuous analyzers include:

- Sulphur Dioxide (SO_2) - monitored in Guelph and Kitchener for general ambient levels. SO_2 is a product of fuel combustion. Air quality criteria and their underlying limiting factors are:

1-hour average	-	.25 ppm (vegetation effects)
24-hour average	-	.10 ppm (health effects in conjunction with particulates)
1-year average	-	.02 ppm (vegetation effects)

- Carbon-Monoxide-(CO) - general ambient levels are measured in Kitchener. The major source of CO is the automobile. Criteria for CO are:

1-hour average	-	30 ppm (health effects)
8-hour average	-	13 ppm (health effects)

- Ozone (O_3) - measured in Kitchener to check general ambient levels. Oxidants are products of photochemical reactions involving oxides of nitrogen, hydrocarbons and sunlight and ozone accounts for most of the oxidants produced. The sources of the precursor pollutants are mainly industrial and automotive. Concentrations follow very definite annual and daily trends with highest levels occurring during the summer, and daily maxima usually occurring in mid-afternoon. Both patterns are directly related to temperature and the amount and intensity of sunlight. Ozone and its precursors can be transported over great distances and can be augmented by local sources. Most of the high levels measured in Southern Ontario each summer arrive from the United States. An objective for ozone is:

  1-hour average - 80 ppb (vegetation effects)

- Oxides of Nitrogen - general ambient levels were measured in Kitchener. They are a product of high temperature combustion sources including the automobile. The most abundant oxides are nitric oxide (NO) and nitrogen dioxide (NO_2). Criteria exist only for NO_2:

  1-hour average - .20 ppm (odour)
  24-hour average - .10 ppm (health effects)

b) Particulates (dust) are measured by two methods, each relating to a different size range of particles.

- Dustfall - heavy material generally greater than 10 microns in size (one micron is one-millionth of a metre) that settles out of the atmosphere by gravity.

A plastic container is exposed for one month and the collected dust is weighed and expressed as a deposition rate of grams/square metre/30 days. The measurement is imprecise and observations are restricted to relatively local areas. Criteria are:

1-month average	- 7.0 $g/m^2/30$ days	(nuisance effects)
1-year average	- 4.5 $g/m^2/30$ days	(nuisance) effects)

- Total Suspended Particulates (TSP) - measured with high volume (hi-vol) samplers near industrial sources and for general ambient observations. The particles range from submicron to about 50 microns in size. The hi-vol sampler draws air through a glass fibre filter for a 24 hour period. The exposed filter is weighed and the weight of solids collected is converted to an equivalent concentration in air. Units used are micrograms per cubic metre. The samplers run once every six days. Criteria based on health effects in conjunction with sulphur dioxide are:

24-hour average	- 120 ug/m^3	(health effects)
1-year geometric mean	- 60 ug/m^3	(health effects)

DATA ANALYSIS

Ayr

Dustfall was measured near the Date Industries Foundry at station 26026 on Stanley St. (Figure 2) and remained extremely high year-round, well above objectives except for one month as shown in Table 7 (one sample was invalid). Of equal concern is that levels at this station have been steadily increasing since 1979, as shown in Figure 12.

Preliminary in-plant surveys of this foundry have not revealed any obvious evidence of unacceptable emissions and complaints have been few. However, no other pollution source in the area is apparent, and in an effort to ascertain the source of the high readings, microscopic analysis of the samples was begun in 1986. Those analyses did show the presence of foundry materials in the 1985 samples, but substantial quantities of grain dust and oily soot were also found.

Abatement staff will complete a survey of the plant to determine sources of the particulate emissions from the foundry.

Breslau

Dustfall near Breslube measured at station 26036 on Fountain Road (Figure 3) improved significantly (Table 7) as the monthly objective was exceeded only twice, compared to 9 times in 1984. The trend graph in Figure 11 reflects the improvement. The greatest potential source of dust at Breslube are storage piles of lime. In 1985 these piles were newly enclosed in a building and this seemed to reduce the impact on local air quality.

The samples were analyzed for calcium (lime is calcium carbonate) and lower concentrations were found than in 1984. However, the calcium levels correlated very well with the total loading data indicating that Breslube still influenced the readings, although to a much lesser degree.

In September the Ministry's Air Resources Branch conducted a three-week post-abatement survey of Breslube with a mobile air monitoring van to confirm compliance with the Ministry's Control Order.

Concentrations of sulphur dioxide, total reduced sulphurs, oxides of nitrogen, ozone and specific organic compounds were monitored and met all guidelines, standards or objectives. Levels were similar or lower during this survey than during a similar one in 1984.

Process emissions would appear to be now under control, barring upset conditions, but it should be noted that these upsets can occur frequently, and cause odour problems in the vicinity of the plant and a large area of Kitchener. Attempts are being made to minimize these problems. In 1985, a new vacuum distillation system was brought on line and it was thought that this installation improved air quality. Further measures to be undertaken in 1986 should further improve air quality.

Guelph

Sulphur dioxide measured downtown at station 28025 at Farquhar and Wyndham (Figure 4) continued to record mostly very low levels and all objectives were met (Table 1). The pollution rose in Figure 6 indicates highest average concentrations (albeit very low) arrived from the south. The SO_2 trend graph in Figure 12 illustrates the low stable concentrations measured here since 1981, well below the annual objective.

Suspended particulate concentrations measured at 28025 were also very low year-round, similar to levels in rural areas (Table 5). There was only one sample which exceeded the daily objective on May 31 during a severe windstorm.

Interestingly, the trend graph for suspended particulates in Figure 13 shows that the Guelph and Kitchener stations display identical trends from 1981 to 1985. The variations which occur then are likely due to mesoscale phenomena, i.e., long range transport of particulates into the area from distant sources.

Suspended particulate concentrations were also measured near Dolime (a lime quarry operation) at station 28027 at the sewage treatment plant on Waterloo Ave. (Figure 4). Concentrations remained unchanged from 1984. The yearly objective was marginally exceeded and seven samples exceeded the daily objective, some by a large margin (Table 5). Correlation of the data with wind direction indicated fairly strong correlationships with east and southeast winds, ie., from Dolime.

The filters were also newly analyzed for carbonate (lime is calcium carbonate) and summary statistics are given in Table 6. The carbonate concentrations correlated fairly well with the suspended particulate readings (Figure 17). This further confirmed Dolime to be the major source of particulates in the area.

The source of particulate emissions at Dolime are their lime kilns. A Control Order was served on Dolime in 1986 requiring that controls be installed by May 31, 1987.

Kitchener

The main monitoring station 26029 at Edna and Frederick (Figure 5) continued to show acceptable levels of sulphur dioxide, carbon monoxide and nitrogen dioxide meeting all criteria (Tables 1, 3 and 4). Trend graphs in Figures 12, 14 and 15 illustrate stable levels dating back to 1977.

Ozone concentrations (Table 2) also remained relatively unchanged, with 27 hours above the hourly objective. The trend graph of exceedence events in Figure 16 shows random variation from year to year, which is mostly related to weather variability, that is, temperatures and quantities of sunshine each summer, when all exceedences occur.

Pollution roses are presented in Figures 7 to 10 and with the exception of ozone, all peaks occurs under northeast, east or southeast winds - from the adjacent Conestoga Parkway.

The rose for ozone (Figure 10) peaks under south and southwest winds. Ozone is mainly a photochemical product of long range transport of precursor pollutants (hydrocarbons and oxides of nitrogen) from the United States. It should be noted that southerly winds do not automatically carry high ozone, even during the summer. Specific meteorological conditions are necessary.

Suspended particulates measured at Edna and Federick were lower than in 1984 (Figure 13), a trend common to the Region. The yearly objective was not exceeded, and there was only one sample above the daily objective (Table 5), that on May 31 due to the windstorm previously mentioned. Further, as discussed in the Guelph section, annual trends between Kitchener and Guelph are identical, reflecting mesoscale phenomena, i.e., variations in long range emissions entering

the area. The higher levels in Kitchener as compared to Guelph evident in Figure 15, are attributed to the Kitchener station's proximity to the adjacent Conestoga Parkway.

Dustfall was monitored at Station 26040 on Guelph Avenue (Figure 5) near Hogg Fuel and Supply - a cement manufacturer. Elevated concentrations above the monthly objective were found in 6 samples, similar to 1984 (Table 7). However, microscopic analyses of the dust have shown little evidence of cement plant materials. The samples were composed usually of road dust or biological materials. Although the company does not appear to be the major source of the sampled material, the company will be installing a baghouse in 1986 to further improve their emission control system.

DISCUSSION

This report has summarized the results of routine air monitoring in the Waterloo and Wellington areas. Where local industrial air pollution problems have been identified, the sources involved will be compelled to reduce their emissions through abatement programs or by Control Orders. Other industrial sources monitored show little evidence of problem emissions but will continue to be carefully monitored.

General air quality as characterized by our stations in downtown Guelph and Kitchener was very good.

In 1987, a new air quality data telemetry system is to be installed throughout the Province. This new system will permit all of the Ministry's stations with continuous analyzers to send data directly to a central computer facility in Toronto. This will allow for data collection on a real-time basis. Currently, none of the stations in the Waterloo and Wellington areas are telemetered. Both existing stations in Guelph and Kitchener with continuous analyzers, require manual reading of strip charts for the data. This causes delays in the availability of our data, amounting to several months. The new system will allow for immediate access to the data, both in the Regional Office in Hamilton and in Toronto and will also allow for remote control and maintenance of the instruments. As well, meteorological instruments will be installed, likely near Kitchener, providing wind and temperature data continuously for the area. All of this will result in a more efficient monitoring program.

Once the new system becomes operational, a new expanded Air Quality Index (AQI) will be added to the current API which refers to only two pollutants. The new AQI will be a

function of six different pollutants, which will form up to 8 separate subindices. Concentrations of sulphur dioxide, soiling index, carbon monoxide, nitrogen dioxide, total reduced sulphur and ozone will all be individually converted to the current scale of index numbers with the same advisory or alert levels as the current API, ie., 32, 50, 75 and 100. Not all stations will measure all of the parameters, but the highest subindex and the pollutant causing it will be reported several times daily to the public. In the Waterloo and Wellington area, the new AQI's will be reported for the existing Kitchener station, a new Guelph station and a new station in downtown Waterloo. The new system has the potential to add more communities in the future. The intent of the new index is to better inform the people of Ontario of air quality in their local area.

ACKNOWLEDGEMENT

We would like to thank the University of Guelph for providing their Elora Research Station wind data.

FIGURE 1

Wind Frequency Distribution - 1985

Elora

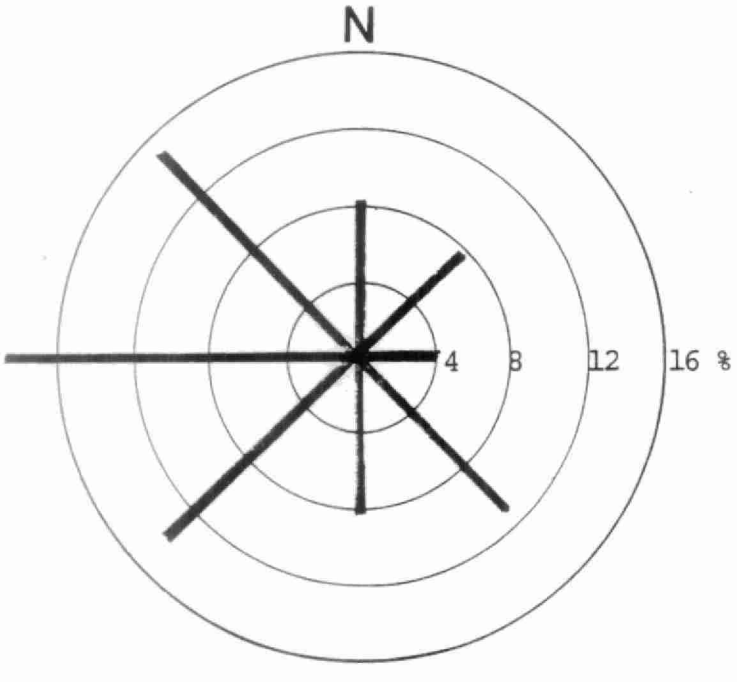


FIGURE 2

Ayr Air Monitoring Station

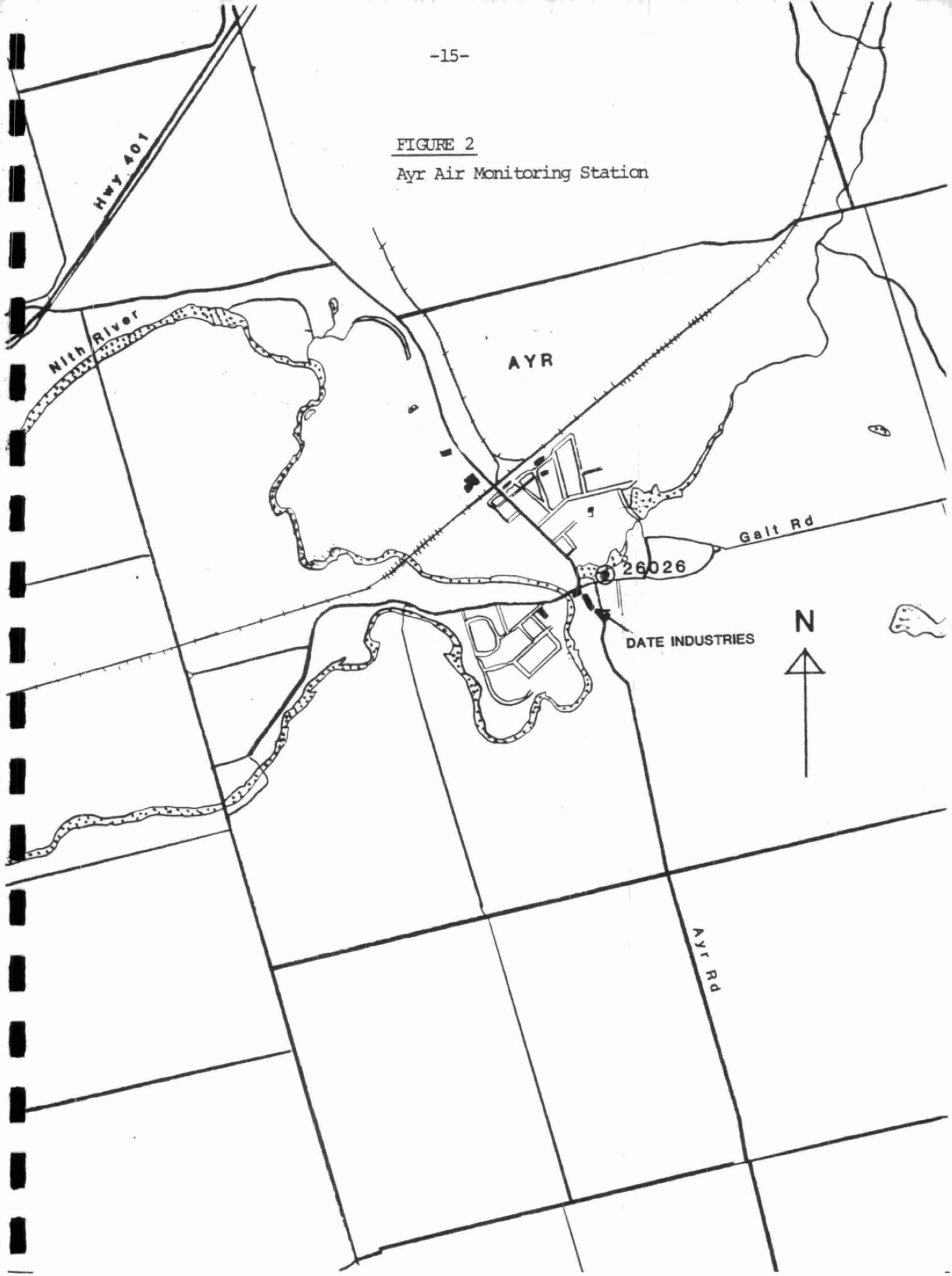


FIGURE 3
Breslau Air Monitoring Station

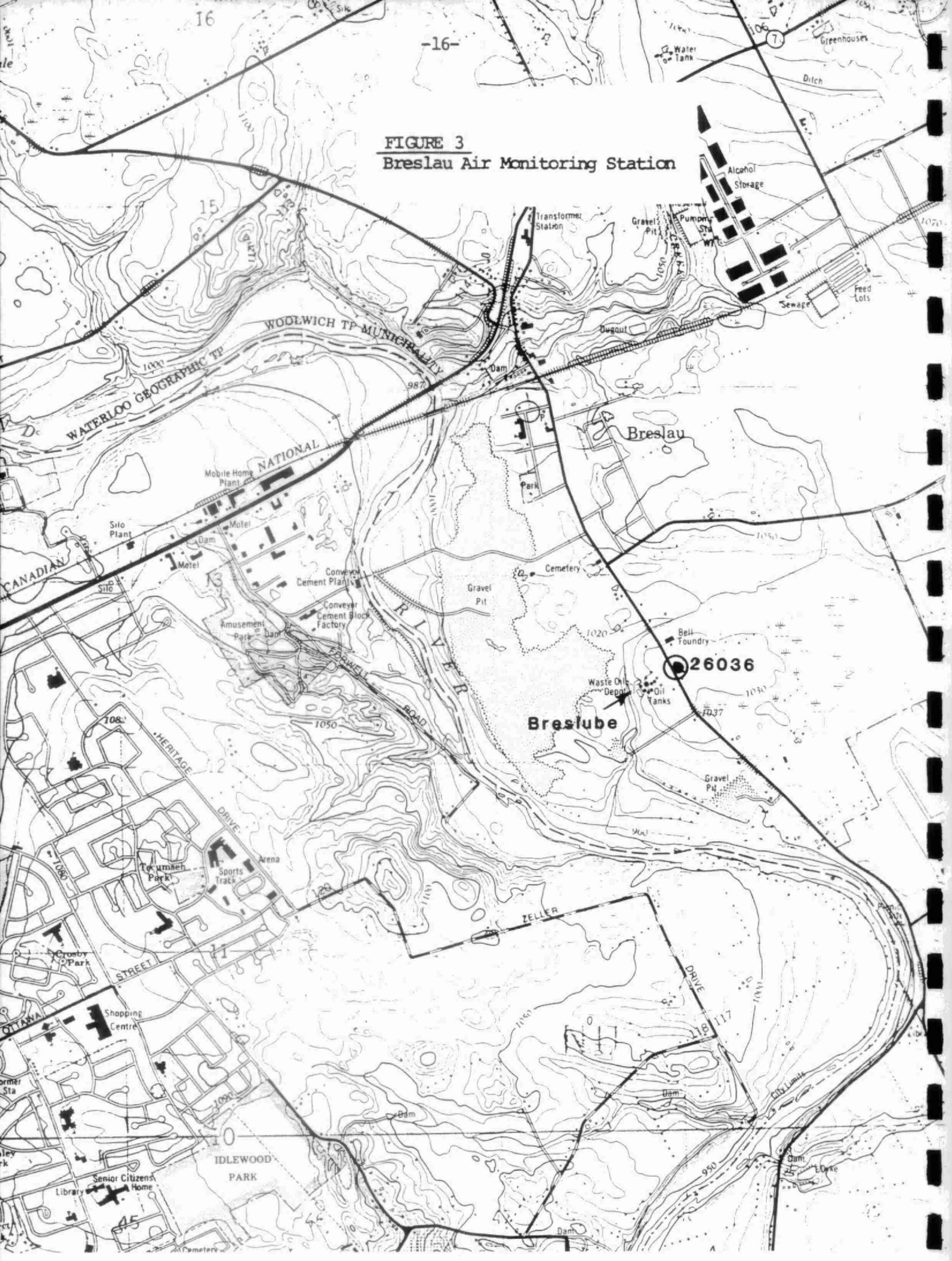
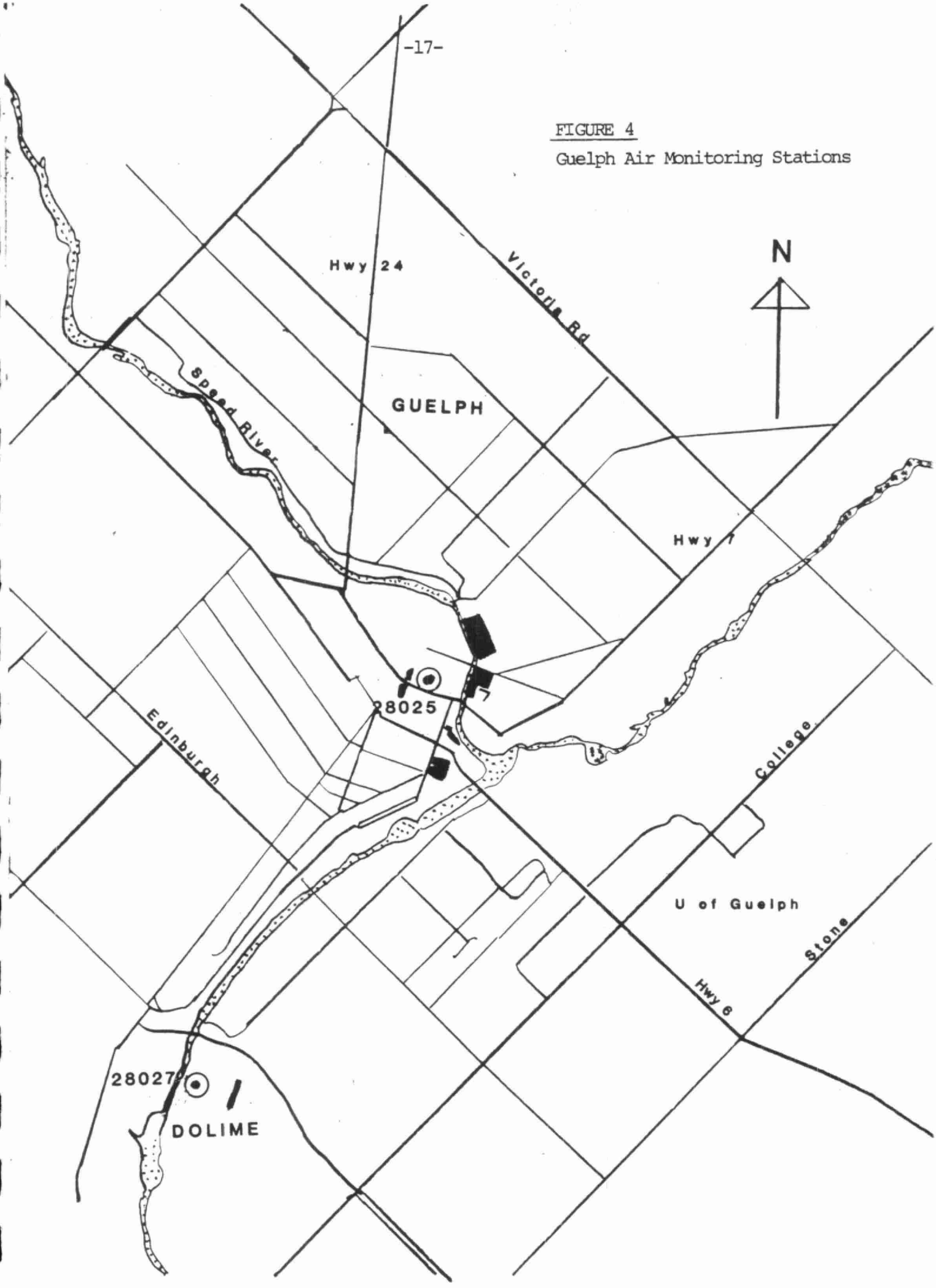


FIGURE 4

Guelph Air Monitoring Stations



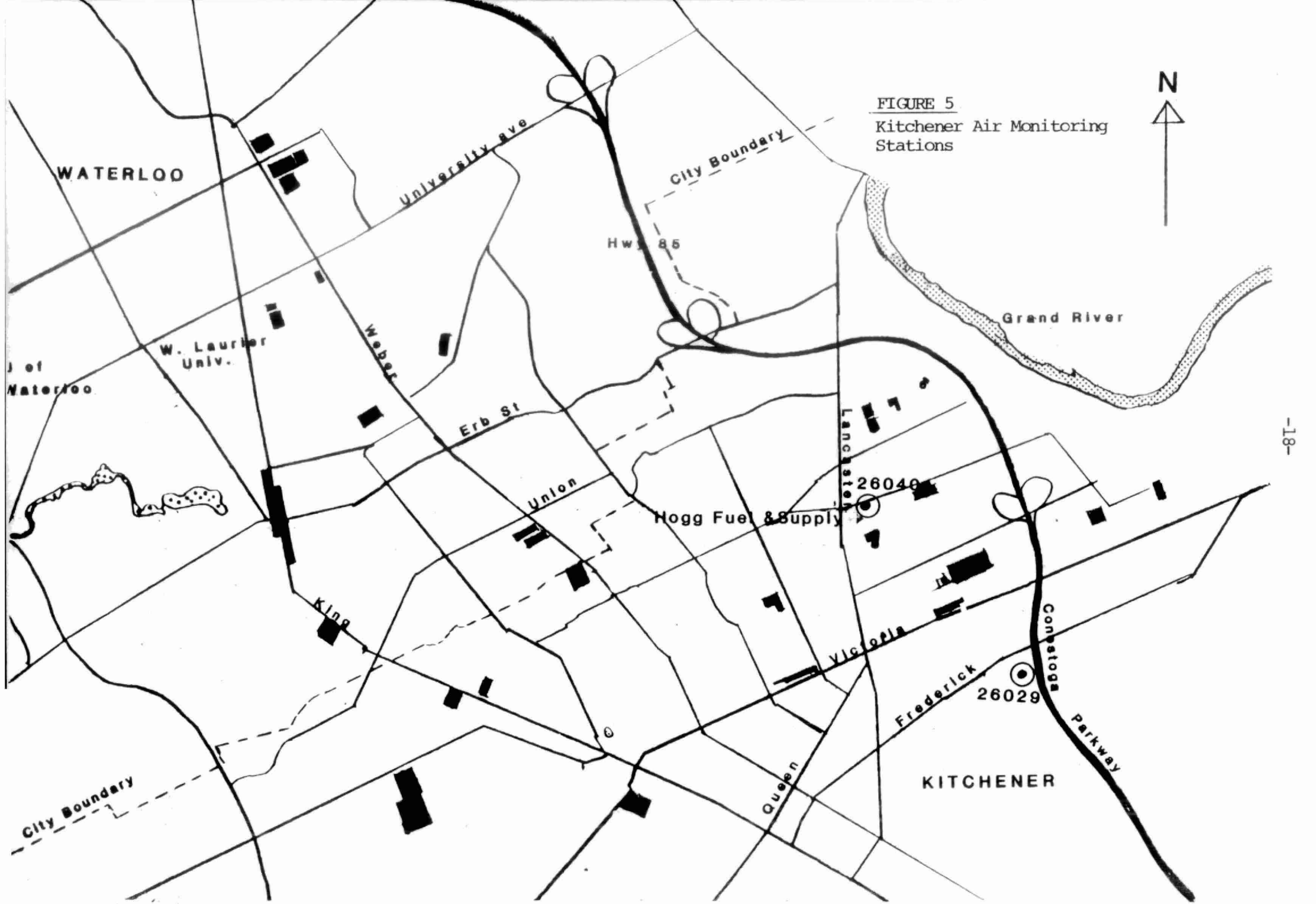


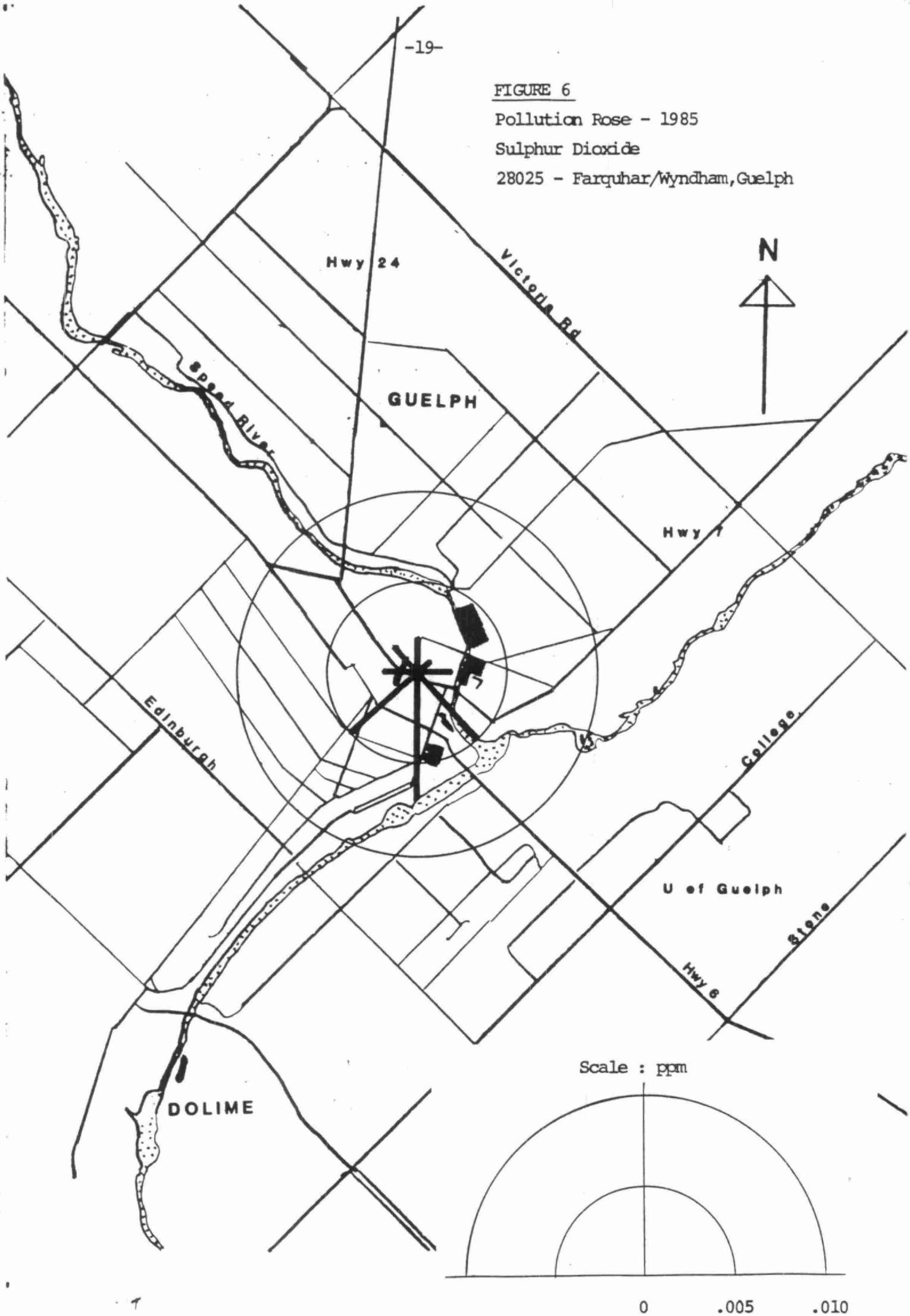
FIGURE 5
Kitchener Air Monitoring Stations

FIGURE 6

Pollution Rose - 1985

Sulphur Dioxide

28025 - Farquhar/Wyndham, Guelph



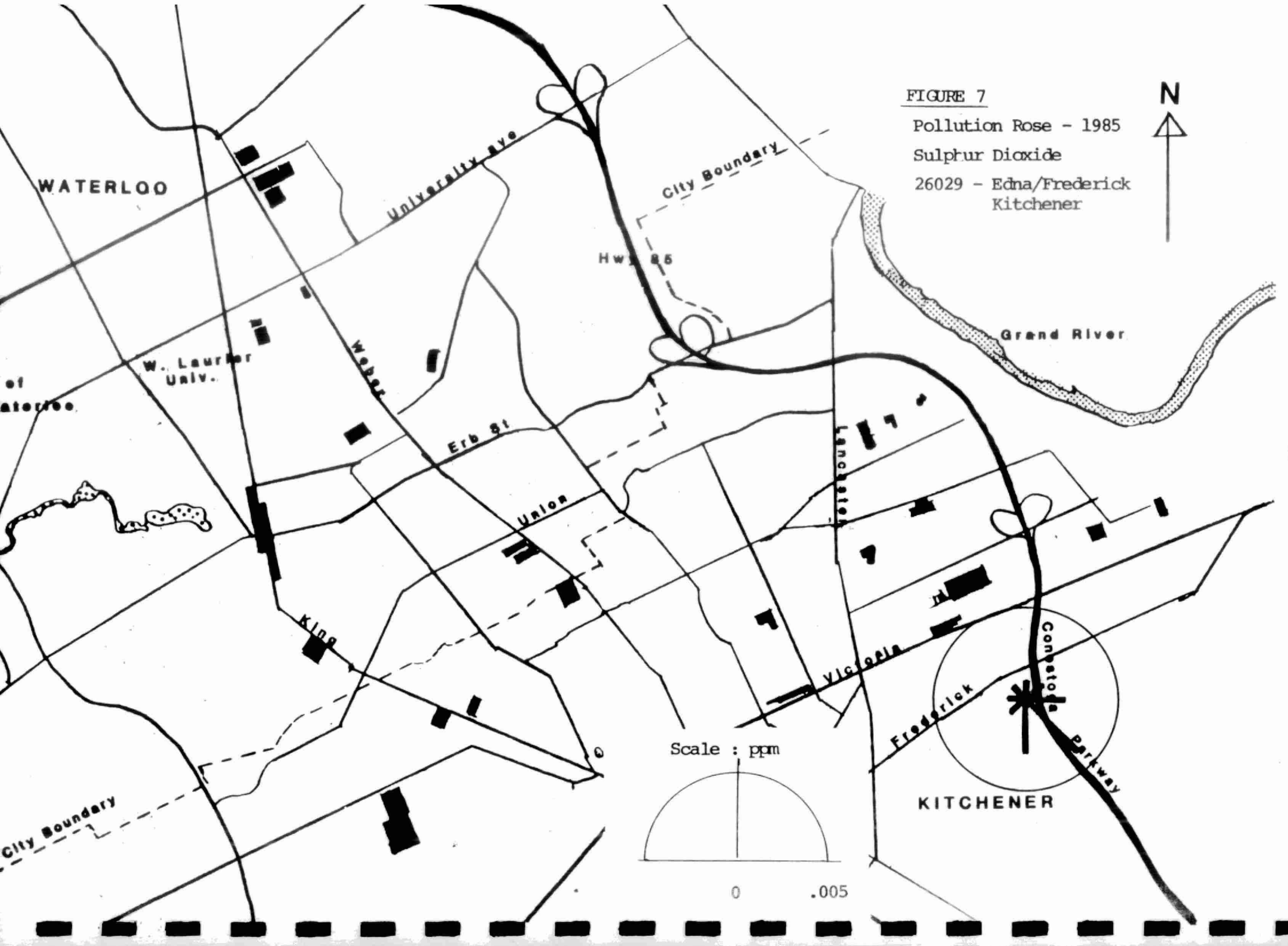


FIGURE 7

Pollution Rose - 1985

Sulphur Dioxide

26029 - Edna/Frederick
Kitchener

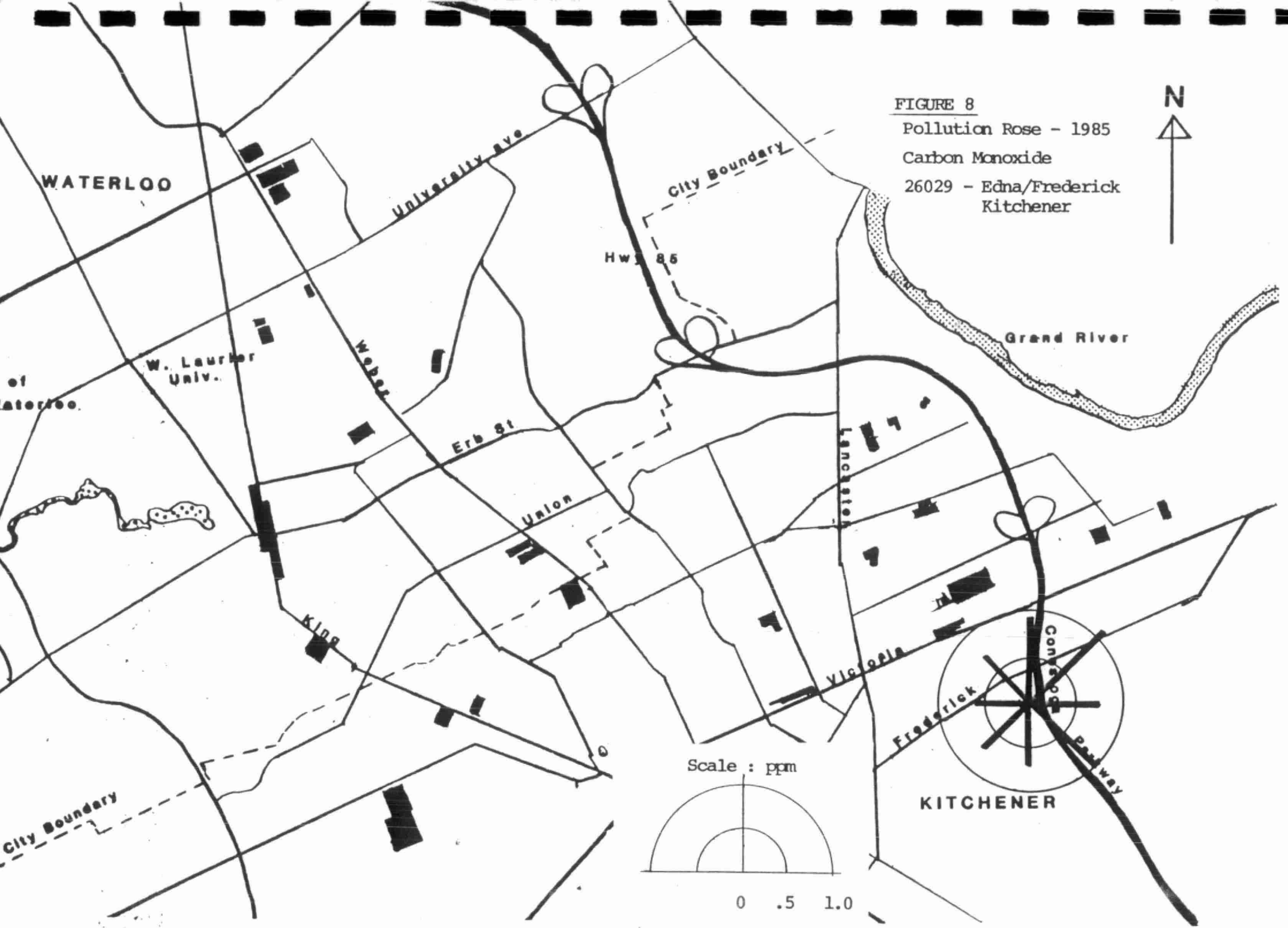


FIGURE 8

Pollution Rose - 1985

Carbon Monoxide

26029 - Edna/Frederick
Kitchener

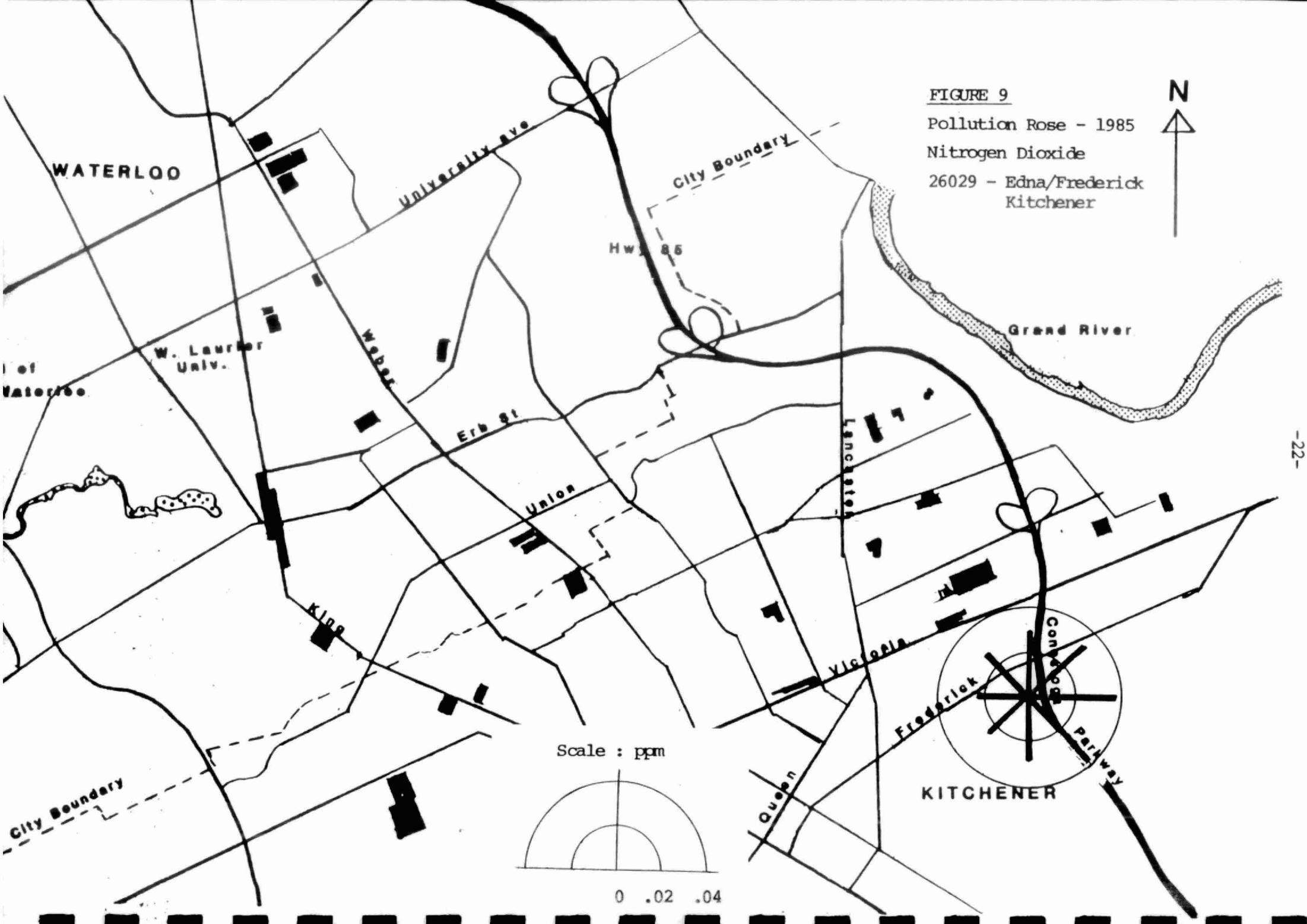


FIGURE 9

Pollution Rose - 1985

Nitrogen Dioxide

26029 - Edna/Frederick
Kitchener

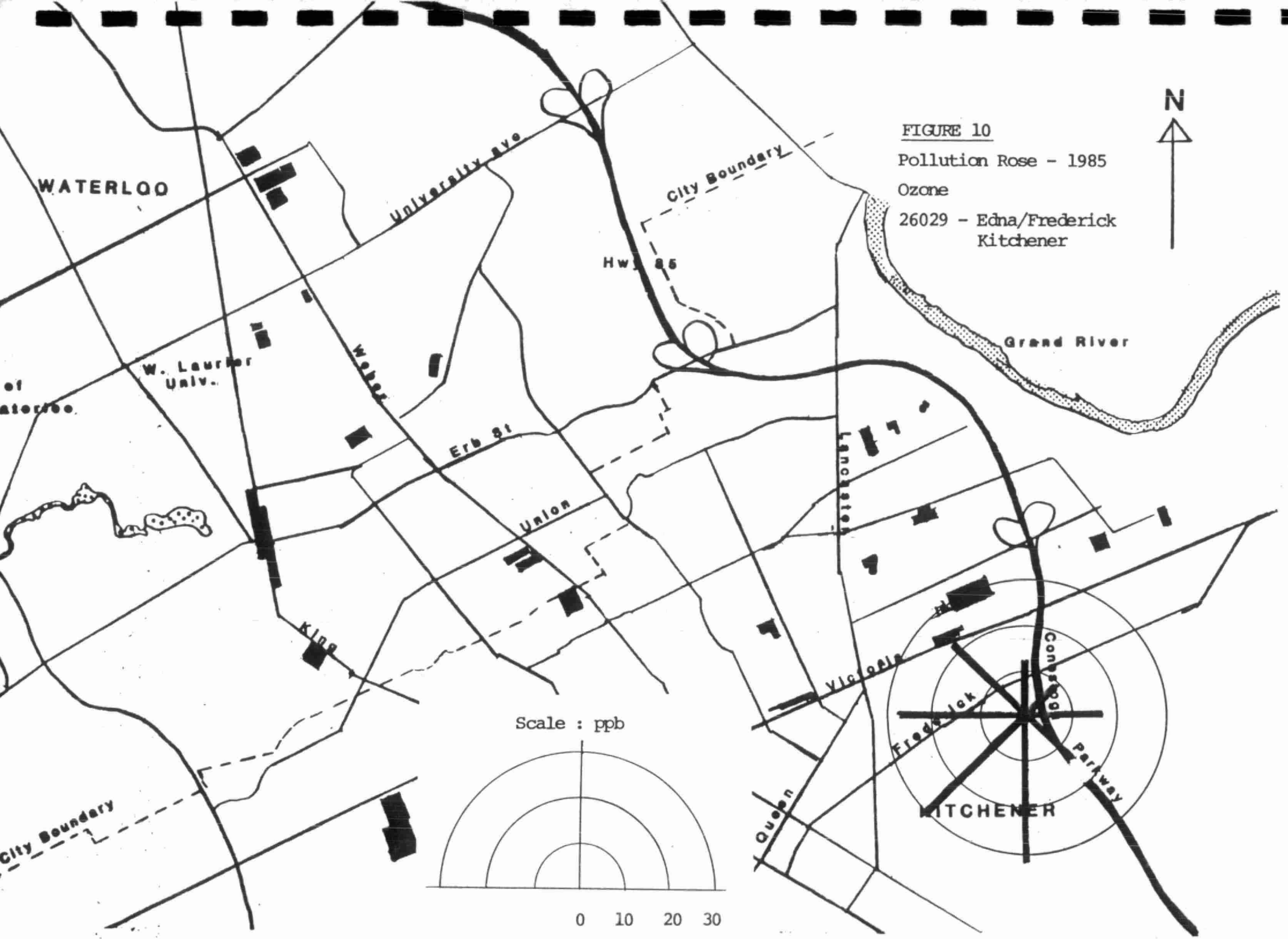


FIGURE 10

Pollution Rose - 1985

Ozone

26029 - Edna/Frederick
Kitchener

FIGURE 11

DUSTFALL YEARLY TREND

DATE INDUSTRIES (AYR) & BRESLUBE (BRESLAU)

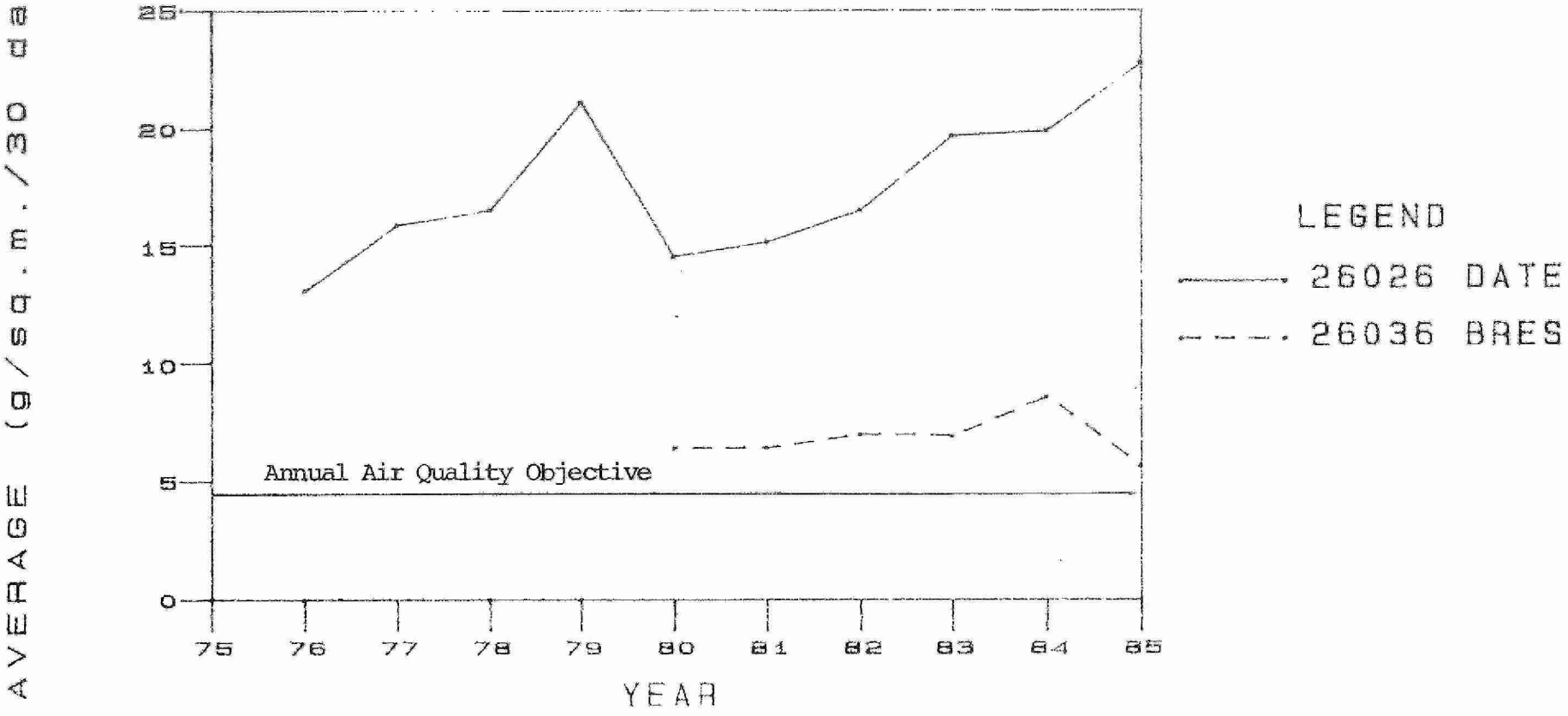


FIGURE 12

SULPHUR DIOXIDE YEARLY TREND

KITCHENER AND GUELPH

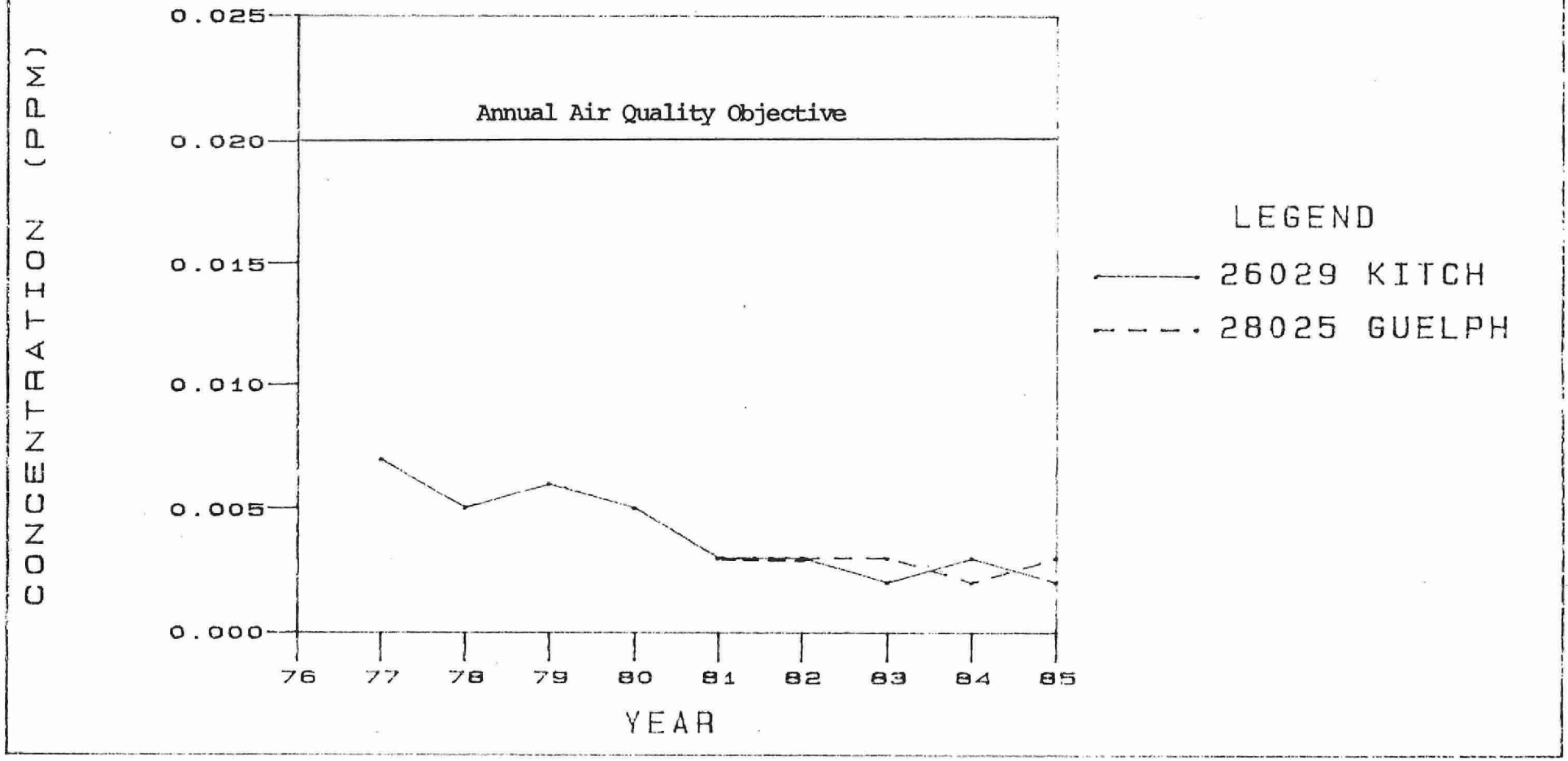


FIGURE 13

SUSPENDED PARTICULATES YEARLY TREND

KITCHENER AND GUELPH

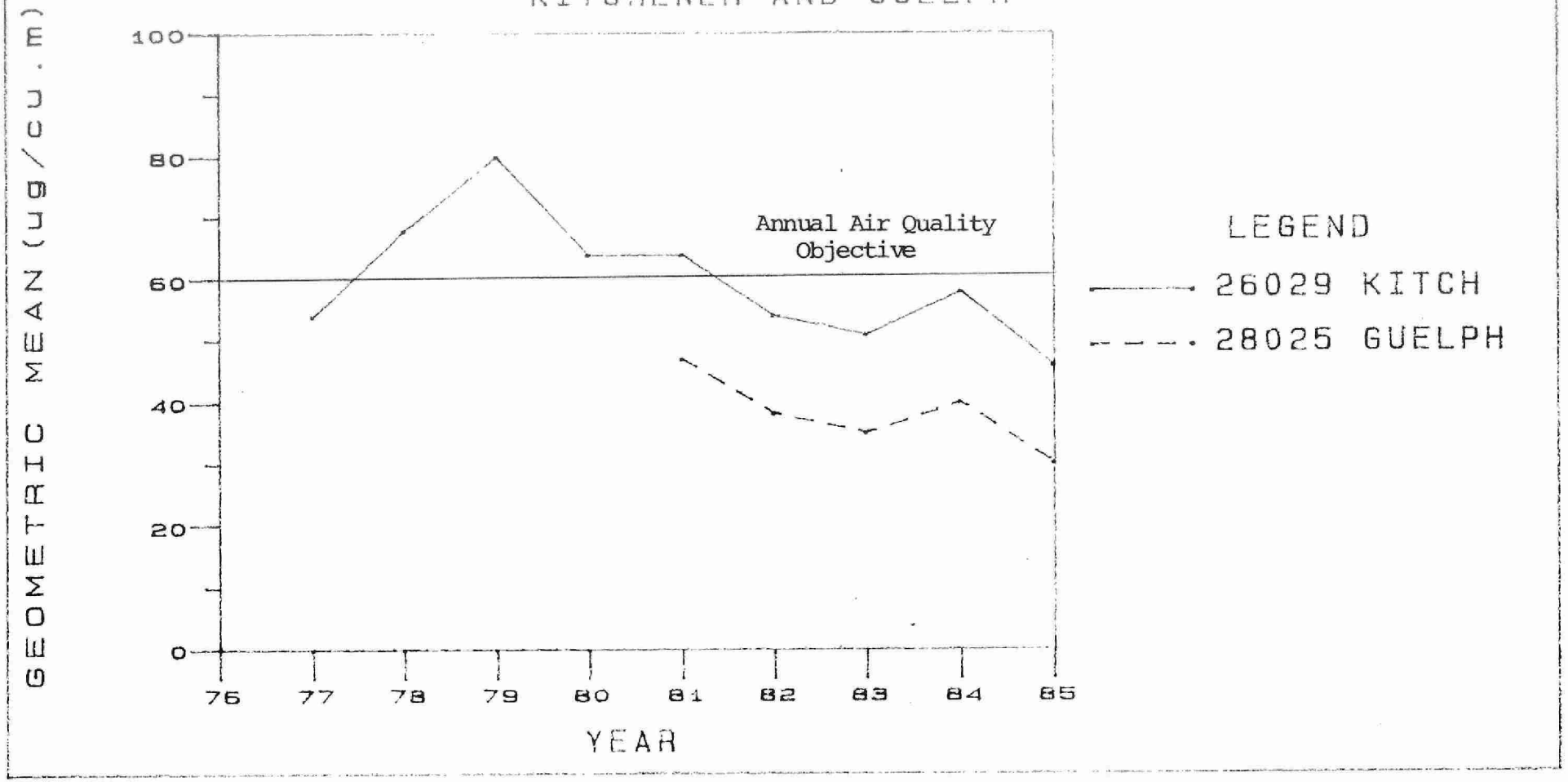


FIGURE 14

CARBON MONOXIDE YEARLY TREND

26029 KITCHENER

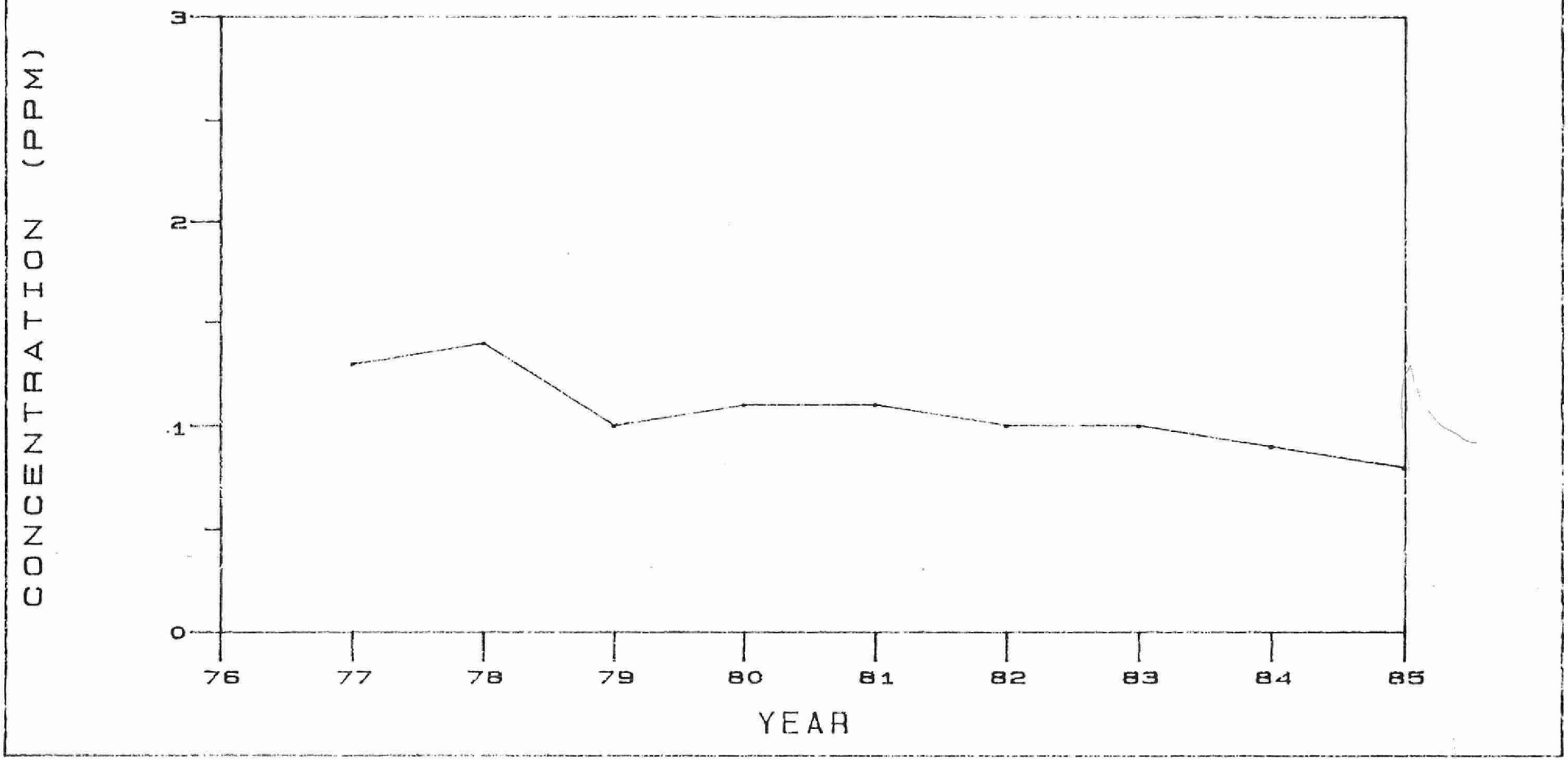


FIGURE 15

NITROGEN DIOXIDE YEARLY TREND

26029 KITCHENER

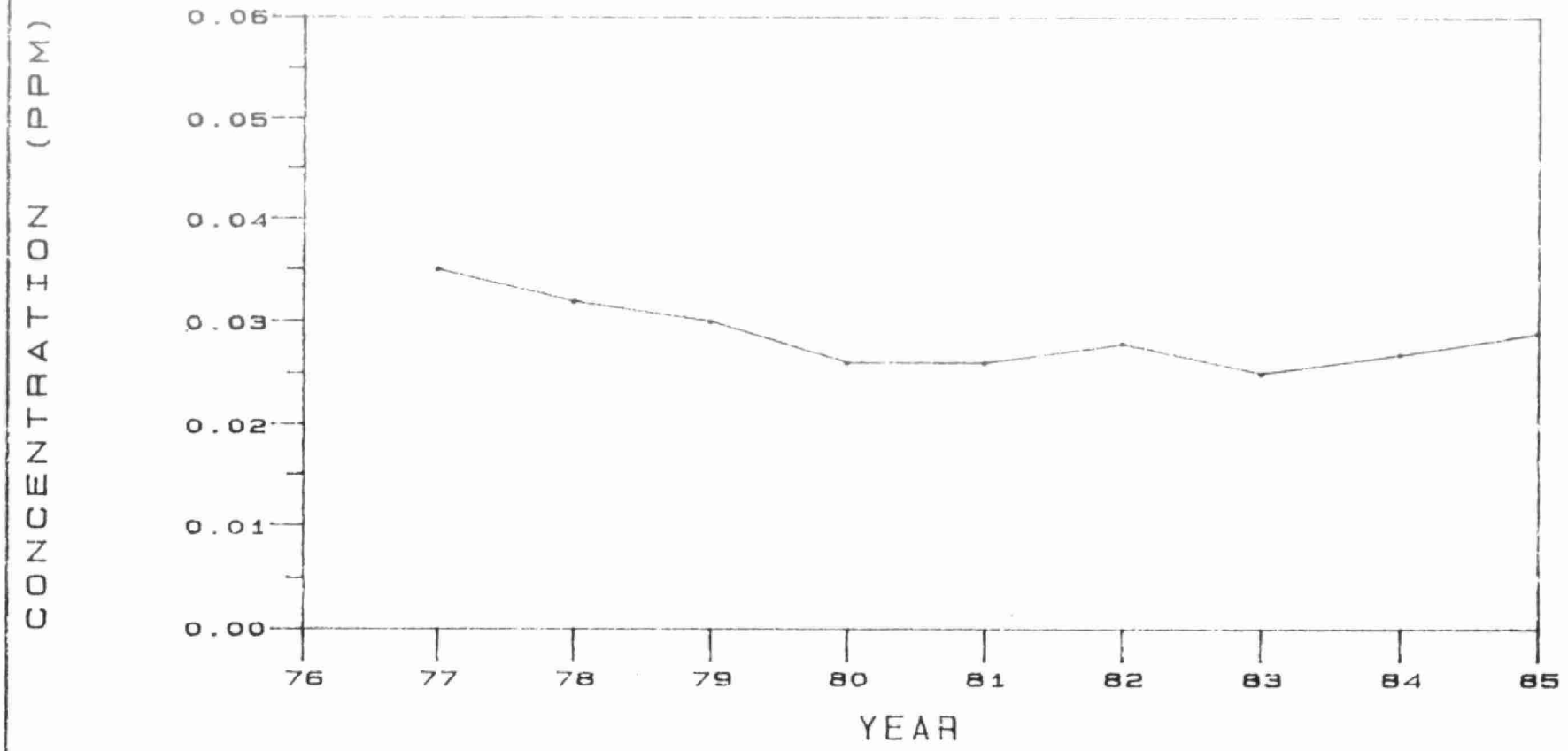


FIGURE 16

OZONE EXCEEDENCE TREND-26029 KITCHENER

HOURS OVER 80 PPB

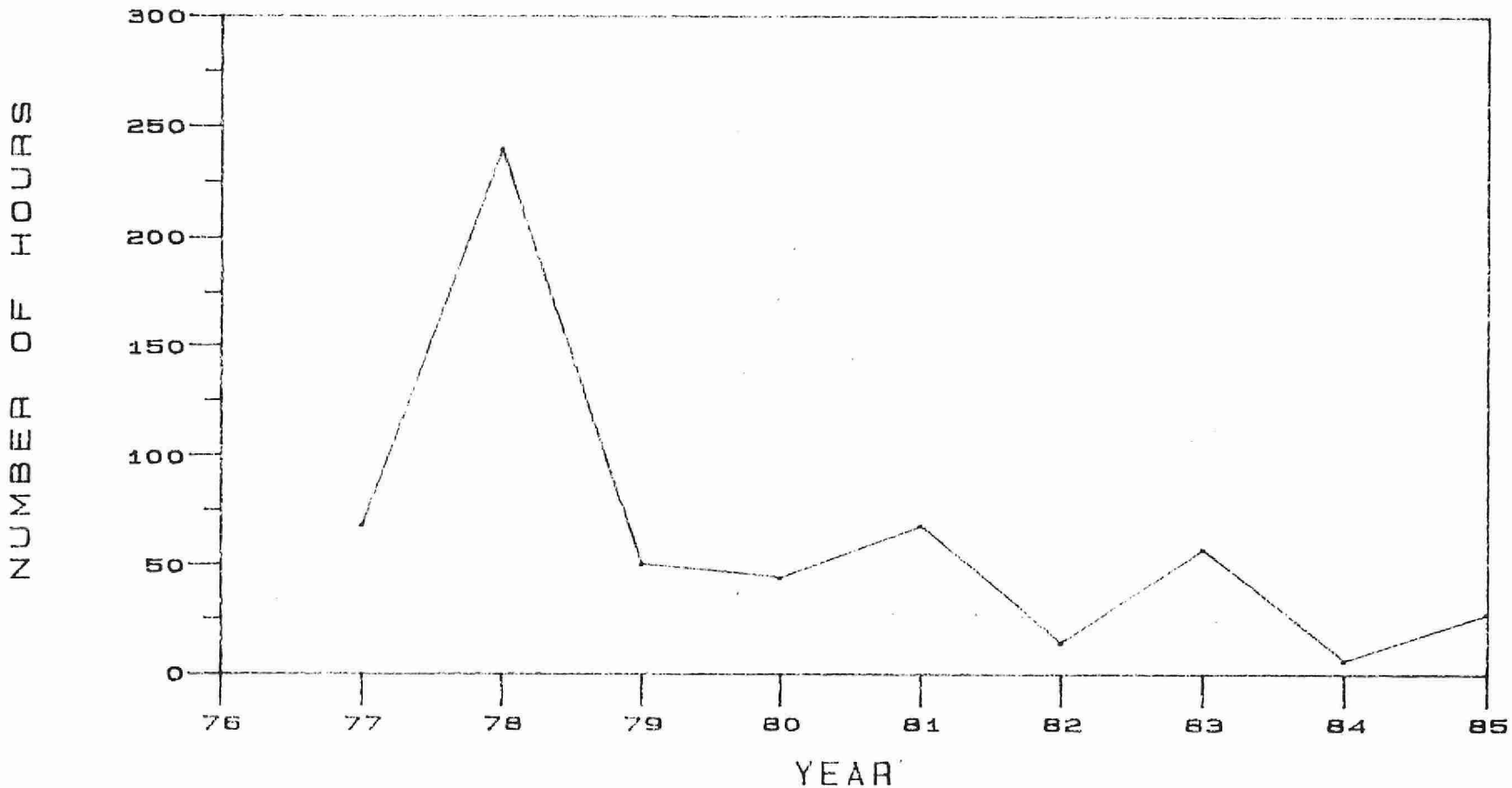


FIGURE 17

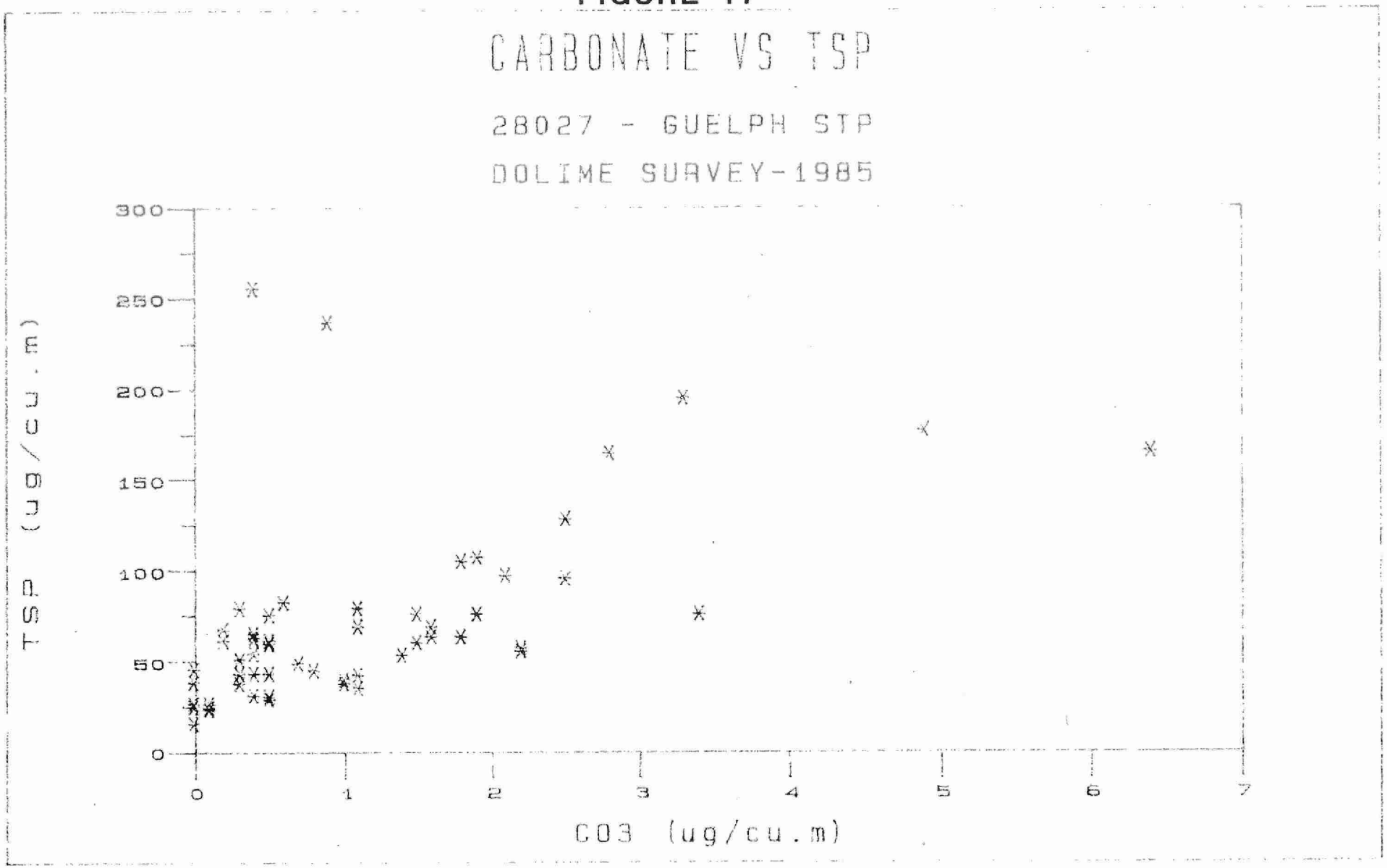

CARBONATE VS TSP
28027 - GUELPH STP
DOLIME SURVEY-1985
TSP (ug/cu.m)
300
250
200
150
100
50
0
0
1
2
3
4
5
6
7
CO3 (ug/cu.m)

TABLE 1
SULPHUR DIOXIDE
UNIT - PARTS PER MILLION

Ontario Objectives: 1-Hour - .25
24-Hour - .10
1-Year - .02

LOCATION	ANNUAL AVERAGE 1983	1984	1985	1985 MAXIMUM 1-Hour	24-Hour	NO. OF TIMES ABOVE OBJECTIVE (1985) 1-Hour	24-Hour	SOURCE MONITORED
26029 Edna/Frederick Kitchener	.002	.003	.003	.11	.03	0	0	General Ambient
28025 Farquhar/Wyndham Guelph	.003	.002	.003	.13	.03	0	0	General Ambient

TABLE 2
OZONE
UNIT - PARTS PER BILLION

Ontario Objective: 1-Hour - 80

LOCATION	ANNUAL AVERAGE 1983	1984	1985	1985 MAXIMUM 1-Hour	NO. OF HOURS ABOVE OBJECTIVE 1983	1984	1985	SOURCE MONITORED
26029 Edna/Frederick Kitchener	18.9	18.3	19.9	105	57	6	27	General Ambient

TABLE 3
CARBON MONOXIDE
UNIT - PARTS PER MILLION

Ontario Objectives: 1-Hour - 30
8-Hour - 13

LOCATION	ANNUAL AVERAGE 1983	1984	1985	1985 MAXIMUM 1-Hour	8-Hour	NO. OF TIMES OVER OBJECTIVE (1985) 1-Hour	8-Hour	SOURCE MONITORED
26029 Edna/Frederick Kitchener	1.0	.9	.8	9	4	0	0	General Ambient

TABLE 4
NITROGEN DIOXIDE
UNIT - PARTS PER MILLION

Ontario Objectives: 1-Hour - .20
24-Hour - .10

LOCATION	ANNUAL AVERAGE 1983	1984	1985	1985 MAXIMUM 1-Hour	24-Hour	NO. OF TIMES ABOVE OBJECTIVE (1985) 1-Hour	24-Hour	SOURCE MONITORED
26029 Edna/Frederick Kitchener	.025	.027	.029	.10	.06	0	0	General Ambient

TABLE 5
SUSPENDED PARTICULATES
UNIT - MICROGRAMS PER CUBIC METRE

Ontario Objective: 24-Hour - 120
1-Year Geo. Mean - 60

LOCATION	GEOMETRIC MEAN 1983	1984	1985	1985 MAXIMUM	% OF SAMPLES OVER 120 (1985)	SOURCE MONITORED
28025 Farquhar/Wyndham Guelph	35	40	30	154	2%	General Ambient
28027 Sewage Tr. Plant Guelph	51	63	61	256	13%	Dolime
26029 Edna/Frederick Kitchener	51	58	46	174	2%	General Ambient

TABLE 6
CARBONATE IN SUSPENDED PARTICULATE
UNIT - MICROGRAMS PER CUBIC METRE

Ontario Objective: None

LOCATION	GEOMETRIC MEAN 1985	1985 MAXIMUM	SOURCE MONITORED
28027 Sewage Tr. Plant Guelph	0.59	6.4	Dolime

TABLE 7
DUSTFALL
UNIT - GRAMS/SQUARE METRE/30 DAYS

Ontario Objectives: 1-Month - 7.0
1-Year - 4.5

LOCATION	ANNUAL AVERAGE 1983	1984	1985	1985 MAXIMUM 1-Month	NO. OF MONTHS ABOVE OBJECTIVE 1983	1984	1985	SOURCE MONITORED
26026 Stanley Street Ayr	19.7	19.9	23.3^{11}	42.6	12	11	10	Date Industries Foundry
26036 Fountain Road Breslau	6.9	8.6	5.5	9.3	5	9	2	Breslube
26040 Guelph Avenue Kitchener	6.8^{10}	6.2^{11}	7.3	14.9	3	6	6	Hogg Fuel and Supply

11 - Numerical exponent refers to number of valid monthly samples when less than 12.